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Screening of community-dwelling older patients by the emergency medical services: An observational retrospective registry study

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ABSTRACT

Background: Inadequate nutrition, falls, and cognitive impairment are common problems among acutely ill older people and are associated with complicated and prolonged health problems and mortality.
Objectives: To assess if the emergency medical services can identify patients with nutritional risk, falls risk, and cognitive impairment by using simple screening tools and to assess the prevalence of risks and rate they are reported to the emergency department.
Setting: The study was carried out in Espoo, Finland to patients over the age of 70 requiring non-urgent ambulance transfer to the emergency department.
Outcome measures: A set of validated electronic screening tools was used to identify patients at nutritional risk, risk of falling and having cognitive impairment.
Main results: A total of 488 (8%) out of 5792 patients were screened. Of the patients 60%, (n = 292) had at least one risk: 17% (n = 81) had nutritional risk, 43% (n = 209) falls risk, and 28% (n = 137) cognitive impairment. Twenty-two (5%) were screened positive in all three categories. The observed risk was reported to the emergency department staff in 59% (n = 173) of the patients.
Conclusion: The emergency medical services can be used in preventive health care to identify patients having nutritional risk, falls risk, or cognitive impairment.

1. Introduction

Malnutrition, falls, and cognitive impairment are significant problems among acutely ill older patients, causing major health care costs [1–8]. Assessment of the nutritional status of hospitalized patients is recommended, as twenty to fifty percent of inpatients are malnourished [1,9–10]. Malnutrition predisposes patients to falls and hinders recovery from injuries, lengthens hospitalization and increases complications, mortality and the probability of recurrent need for hospital care [9–10].

Falls are a significant cause of serious morbidities such as fractures and head injuries in older people. Moreover, they may also lead to fear of falling, lack of confidence, reduced mobility, and social isolation, thus reducing quality of life. [11–12] In the worst case, severe fall-induced injuries can lead to mortality or a need of permanent long-term care [5]. One-third of community-dwelling people aged above 65 years fall each year [12–14]. Fall-related healthcare costs will increase due to ageing population. Falls prevention strategies need to be implemented to reduce fall-related problems. [11]

Cognitive impairment and delirium are associated both with malnutrition [15–16] and falls [2,5]. Even though delirium is common in acute situations, it is often underdiagnosed [3,7,17,18].

The importance of risk assessment and prevention are widely recognized [1,2,10]. Emergency departments (ED) are crowded, and lack of time and resources hinders risk assessment. Emergency medical services (EMS) have been seen mainly as a party to treat and transfer acutely ill patients to the ED and have traditionally not been utilized in preventive health care. EMS meet patients at their homes and have an opportunity to assess the patients' coping at home and could adapt a bigger role in being part of preventive health care.

Several screening tools have been developed to assess the nutrition,

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falls risk and mental state of older people [7,10,18,19,20]. For example, Nutritional Risk Screening (NRS-2002) [10] and Mini Nutritional Assessment (MNA) [21] are quite frequently used on geriatric wards. The aim of this study was to assess if the emergency medical services can identify patients with nutritional risk, falls risk, and cognitive impairment by using simple screening tools and to assess the prevalence of risks and the rate they are reported to the emergency department. Previous studies in which EMS staff have assessed cognitive impairment, nutritional risk, or risk of falling, are scarce.

2. Setting and participants

This observational study was performed between 10 November 2018 and 30 July 2019 in Espoo (population base 300.000), Finland. The study group consisted of all community-dwelling patients aged 70 or over who were met by the EMS, had a non-urgent transportation (n = 5792) to the ED, and were screened for nutritional risk, falls risk and cognitive impairment during their care by EMS staff. All patients filling those criteria were eligible regardless of their morbidities or medications. The assessment was performed mainly during transportation. Only a couple of questions (such as "Is there food in the refrigerator?") needed action at the patient's home.

In Finland, the EMS staff mainly consists of registered emergency nurses (210–240 ECTS). Some of the EMS staff have shorter education (90–180 ECTS). In this study, the educational background of the participating EMS staff was not specified.

3. Nutritional risk

The Nutrition Risk Screening 2002 (NRS-2002) tool was used to identify the risk of malnutrition [10]. In NRS-2002, the nutritional risk is assessed based on unintentional weight loss and changes in food intake (4 items, 0–3 points), effect of diseases on nutrition (4 items, 0–3 points), and age (over 70 adds one point). A total of three points or more indicates a risk of malnutrition. The question concerning body mass index (BMI) in the original NRS-2002 was excluded, as it was considered very likely that patients do not know their exact weight and height and the EMS have no equipment for measurements. The EMS was instructed to observe whether the patient had food in the refrigerator or had a meal service or any other home care service. (Appendix 1.)

4. Falls risk assessment

Falls risk was assessed by the ED falls risk screening tool [22] supplemented by selected questions from the Peninsula Health Falls Risk Assessment Tool (PH-FRAT) [19]. The tool is a simple, two-item screening tool focused on prediction of falls (two items, 1–2 points). Of the 4-item PH-FRAT, the question about self-reported falls over a 12-month period (four alternatives, 0–3 points) was used. A total of three or more points (maximum of 6 points) is considered a positive screening result and the patient to be in risk. (Appendix 1.)

5. Delirium and cognitive impairment

Cognitive impairment was assessed by the 4 A's test (4AT) [7,17] which includes also the Abbreviated Mental Test (AMT4) [20]. The 4AT consists of several parts: Alertness Status (0 or 4 points), AMT4 (0–2 points), Attention (0–2 points), and Acute change or fluctuating course of symptoms (0 or 4 points). A score of three points was set as the limit for a positive result. To reach a positive result in 4AT test, one had to have abnormal findings in AMT4 combined with attention assessment. (Appendix 1.)

6. Outcome measures and analyses

Each of the three sections of the risk assessment (cognitive impairment, malnutrition, falls risk; see Appendix 1) was scored separately based on the answers given and observations made by the EMS workers. The screening tools were placed in the real-time electrical reporting and management system (Merlot Medi, CGI Suomi Oy, Finland) that was already in everyday use, and they were filled mainly during the transportation. Screening was not done if the patient required EMS workers' attention and treatment during transportation or could not answer the screening questions. The EMS staff were instructed to report to the ED staff on a patient with a positive result in any of the screenings.

Categorical data are presented as count with percentages in parentheses (%). Chi-squared analyses were performed to test for an association between categorical variables (nutritional risk, falls, delirium and cognitive impairment, gender). The association between categorical and continuous variables was assessed using Mann–Whitney U tests for non-normally distributed data (age). The significance level was $P < .05$. Statistical analysis was performed by using SPSS (Statistical Package for the Social Science, Version 25, 2015).

7. Ethics approval and consent to participate

Performing risk assessment to older patients was introduced as a permanent part of patient examination routine to the EMS in Espoo region, Finland, in June 2018. As the risk assessment was a standard routine patient consent was not required. All the data from the EMS patient reporting system is open for the ED personnel to see. The data for this study was collected retrospectively. According to the Finnish legislation no ethical approval and consent is required for registry studies. The research permission was requested appropriately from Helsinki and Uusimaa Hospital District.

8. Results

The risk assessment was performed on 488 patients, representing 8% of the 5792 non-urgent transfers to the ED. The reasons for the missing screening records (i.e., living in care facilities, being unable to answer the screening questions or needing acute caretaking during the transfer) could not be defined from the data. Sixty-two percent (n = 303) of the patients were female. The mean age was 82.8 ± 5.4 years (range 70.3 to 103.7 years). A total of 17% (n = 84) of the patients had a meal service and 45% (n = 222) had other homecare services. A majority (88%, n = 74) of the patients with a meal service had also other home care services.

The falls risk assessment scales were the most accurately filled. In only 10 (2%) out of 488 cases the data was missing. In nutritional risk assessment, approximately 30–35 (6–7%) answers were missing in each item. The data on questions on meal service and other home care services were missing in 15 (3%) cases. In assessment of alertness, AMT4 and acute change and fluctuating course of symptoms data were missing in 30–38 (6–8%) cases, but the assessment of attention was not reported in 67 (14%) cases.

Sixty percent (n = 292) of the patients were screened to be in at least one risk group, but the ED was informed of only 173 of these individuals (59%). (Fig. 1) A total of 22 (5%) patients had a positive result in all three screenings. Out of them, the positive screening results were reported to the ED in 15 (68%) cases.

9. Nutritional risk assessment

Sixteen percent (n = 81) of the patients were found to be at nutritional risk and the ED was informed on 64% (n = 52) of them (Fig. 1). Of all patients, 28% (n = 138) reported having unintentional weight loss or loss of appetite in the past three months and 26% (n = 125) had an increased nutritional need caused by a morbidity. Most patients (n = 53, 65%) at risk scored 3 points and the highest NRS-2002 score achieved was 6 points (n = 2, 2%). (Table 1) Of all patients screened positive with any of the screening tools, a total of 5% (n = 16) had no food in their

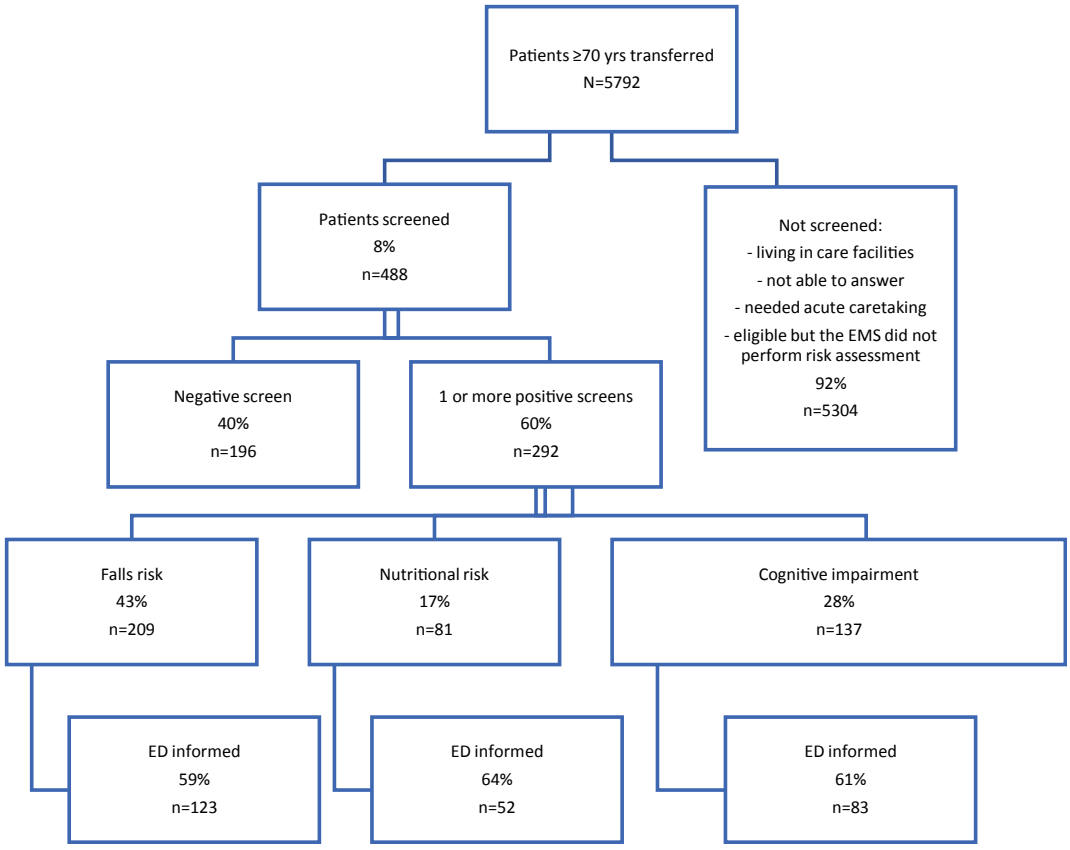

Fig. 1. Flow chart of the study.

Table 1
Results of nutritional assessment of all patients with NRS*-2002 items (N = 488).

Item	n=	%
Unintentional loss of weight or appetite		
None	320	66
Weight loss >5% or appetite loss >25%	103	21
Weight loss >10% or appetite loss >50%	21	4
Weight loss >15% or appetite loss >75%	14	3
Data missing	30	6
Increase in nutritional requirements based on severity of disease		
None	328	68
Mild increase	114	23
Moderate increase	11	2
Considerable increase	1	0,2
Data missing	35	7
Total NRS-2002 scores		
1 point	285	58
2 points	122	25
3 points	53	11
4 points	16	3
5 points	10	2
6 points	2	0,4

* Nutritional Risk Screening (NRS)[10].

refrigerator. None of these patients had a meal service and 25% (n = 4) had other home care services. About two-thirds (n = 11, 69%) of all risk patients with no food in the refrigerator were at nutritional risk.

10. Falls risk assessment

A total of 27% (n = 125) of the patients were in falls risk due to frequent falls in the past three months and 35% (n = 172) had fallen at least twice in the past 12 months and used a minimum of six drugs. Eighty-eight (18%) patients met both criteria for falls risk. Therefore, 209 (43%) patients in total were in risk for fallings. Out of those 209 individuals in falls risk, the ED was informed on 59% (n = 123). (Fig. 1, Table 2.)

11. Cognitive impairment assessment

The assessment of cognitive impairment revealed that 28% (n = 137) of the patients had a decreased cognition level. The ED was informed on 61% (n = 83) of them. (Fig. 1)

A total of 9% (n = 45) of the patients had changes in their level of alertness, 25% (n = 123) made at least one mistake during their AMT4 test and 32% (n = 156) had incorrect answers in the attentiveness test. Of the patients 17% (n = 85) was reported on having a sudden change or onset of their cognitive symptoms (alertness, cognition, other mental functions and psychomotor activity). (Table 3)

Table 2
Results of falls risk assessment with the emergency department falls risk screening tool* and PH-FRAT** items (N = 488).

Item	n=	%
Prediction of falls*		
Had fallen twice or more in past 12 months	238	49
Used six or more drugs	312	64
Falls during previous 12 months**		
No falls	172	35
One or more falls in past 12 months	140	29
One fall in past 3 months	47	10
Several falls in past 3 months	125	26

* The emergency department falls risk screening tool[22].
** The 4-item PH Falls Risk Assessment Tool (PH-FRAT)[19].

Table 3
Results of cognitive impairment assessment with 4AT items (N = 488).

Item	n=	%
Alertness		
Normal	413	85
Mild sleepiness, then normal	32	7
Clearly abnormal	13	3
Data missing	31	6
AMT4		
No mistakes	333	68
One mistake	71	15
Two or more mistakes/untestable	52	11
Data missing	32	7
Attention test		
Achieves 7 months or more correctly	266	55
Starts but scores <7 months/refuses to start	51	11
Untestable	105	21
Data missing	67	14
Acute change or fluctuating course		
Began in past 2 weeks and still existing	85	17
Total 4AT score		
0 points	222	45
1–3 points	115	24
≥4 points	112	23
Data missing	39	8

There were patients with one or more positive risk screens in all age groups. In falls risk, the age of 85 and over was a statistically significant factor. In the other risks, age had no statistical significance. (Table 4) Out of the patients assessed to be in falls risk, 53% (n = 110) had no other positive risk assessment results. The nutritional risk was most frequently associated with other problems (n = 57, 70%). In 41% (n = 56) of cases with cognitive impairment, the falls risk as present as well. (Fig. 2)

12. Discussion

The results confirm that by using simple screening tools the EMS can identify patients in all three categories researched; nutritional risk, falls risk, and cognitive impairment. Performing risk assessment on patients aged 70 and older is worthwhile, as the EMS could recognize several risk patients in all age groups researched. The results show that cognitive impairment, risk of falls and nutritional risk are often present simultaneously. The EMS can provide vital information on the patients' overall condition to the ED. This could lead to important interventions thus promoting patients' health.

In this study, 17% of the patients screened were in nutritional risk. The number of patients suffering from actual malnutrition was not researched. Our findings are somewhat consistent with previous studies stating that 6–21% of home-living older people are malnourished [6,16,21]. The results of this study showed that 36% of the patients had fallen at least once during the past 3 months, and 26% had multiple falls. These findings are consistent with a multinational study in which 37% of the patients had fallen in the 90 days prior to their ED visit [6] and underline the importance of identifying and intervening with the fall risk to prevent future injuries. Every-fourth (28%) patient was screened to have cognitive impairment and/or delirium. Similar results have been achieved in a multinational research in which 26% of the patients in the ED had cognitive impairment [6]. However, there is previous evidence on even 42% of the patients in the ED having cognitive impairment [20]. In our study, 47% of the patients scored at least one point in 4AT test, and about half of them scored 4 points or more, indicating probable delirium. This is in line with the observation that over half of the patients suffering from in-hospital delirium have pre-existing cognitive impairment. [2,18]. According to prior studies, the estimated prevalence of delirium in older patients in the ED and acute hospital settings ranges from 9 to 20% [3,6,7,17,18,20,23–25] and with ambulance patients even up to 28% [17].

Table 4
Number of positive screenings in different age groups (N = 488).

Risk	Age				p
	70–74	75–79	80–84	85+	
n	79 (16%)	104 (21%)	116 (24%)	189 (39%)	
Nutritional risk	15 (19%)	19 (18%)	20 (17%)	27 (14%)	0.70
Falls risk	34 (43%)	39 (38%)	41 (35%)	95 (50%)	0.04
Cognitive impairment	21 (27%)	26 (25%)	39 (34%)	51 (27%)	0.50
Identified risk patients	49 (62%)	56 (54%)	69 (59%)	118 (62%)	0.81

The chosen pre-existing screening tools were modified to fulfill the practical requirements of usage in a pre-hospital setting. This study showed that these instruments were feasible although there were some missing data. Nevertheless, the EMS was able to identify risk patients and with somewhat similar results to in-hospital studies. This suggests that the modified screening tools were usable, but they should be validated in future studies, for example by repeating the assessments at the ED. Regardless of the BMI exclusion, the EMS were able to recognize patients in nutritional risk. Importantly, most patients with nutritional risk also had cognitive impairment, falls risk or both. These patients were represented evenly in all age groups. Therefore, even with the limitations, the nutritional screening in this study identified patients requiring comprehensive evaluation.

In this study, only 8% of possibly eligible patients were screened. It has been shown that malnutrition, falls and cognitive impairment are very common in older patients presented in the ED [6]. Since the EMS did not assess every older patient they met, several risk patients probably remained unrecognized.

A part of this study was to assess whether EMS workers inform the ED on patients at risks during the patient handoff. The results in this study revealed a lack of information transfer, as only 59 % of the risk patients were reported to the ED staff. That is somewhat consistent with prior findings stating that only in approximately half of the cases, or even less, the patient's prehospital vital signs, need for immediate interventions, and overall assessment of the patient's condition are passed on to the ED [26]. Currently, the data from the EMS electrical reporting system is not transferred to the reporting system used in the ED. The flow of information could possibly be enhanced by creating an automatic data transfer system.

The handover of patient care is an important step. The passed information on nutritional and cognitive status may affect decision-making concerning the patient's treatment, such as surgeries, intensity of care or patient discharge. [27,28] For example, delirium is strongly associated with prolonged hospital stays, increased risk of falling, cognitive and functional decline, and increased care costs. Up to a third of acute delirium cases could be avoided if the risk, such as underlying cognitive impairment, was recognized and preventive strategies were implemented. [2,29,30] It has been disputed that noisy ED lacking privacy for sensitive assessment may not be a suitable place for cognitive screening [17,20]. This study confirmed that the EMS can perform the assessment of cognitive functions already in the ambulance, and so the negative factors possibly affecting the assessment in the ED can be eliminated. By providing an accurate description of the patient's prehospital condition, the EMS staff can alleviate the workload in the ED for the ED staff to make objective and right treatment decisions and to recognize and react to alterations in the patient's status. Ensuring that the EMS staff understand the importance and effectiveness of risk assessment and how it leads to improvements in the patients' care would probably better motivate them to perform screening. In order for that to

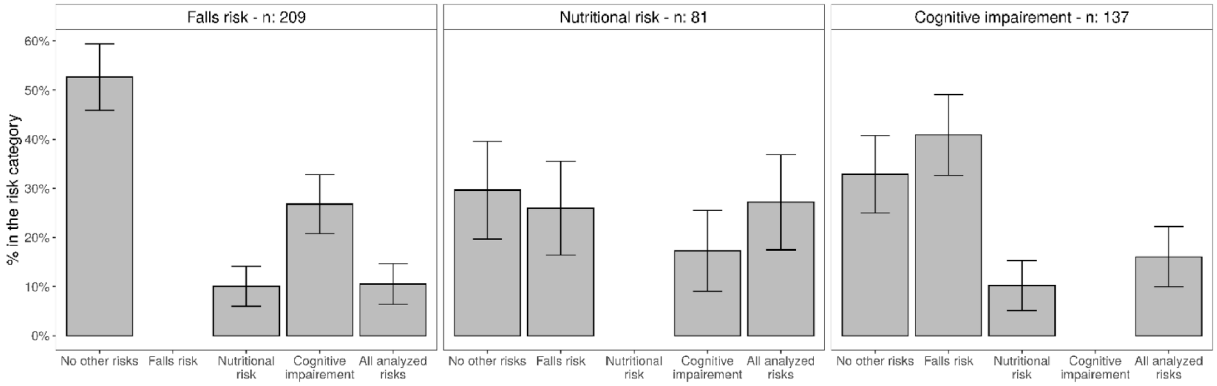

Fig. 2. Combinations of different risk groups among patients over 70 years of age (N = 488) with 95% confidence intervals.

happen, education as well as some cultural and attitudinal change is required.

13. Limitations

There are some limitations to this study. The study was carried out in only one city so the results should be replicated in other areas and countries with different health care systems and different educational background of EMS staff. Screening results were available for only 8% of all EMS missions. Because only the total number of EMS missions was available and the dispatch codes do not give sufficient details, the reasons for missing screening records remained unknown. As part of the total number of missions includes those missions that were not intended for screening, the true coverage of screening is higher.

The EMS were reminded along the way to make risk assessment to all suitable patients. However, it is possible that the EMS staff have unintentionally chosen the patients they performed the risk assessment on. For example, during a fall-related task, the EMS staff may have been more active in performing the risk assessment compared to tasks not so directly related to the risks this study focused on. However, this possible bias in sample selection would not have led to any false positive screening results.

The NRS-2002 and PH-FRAT were modified before using in pre-hospital setting. The BMI section was excluded from the NRS-2002 and just some questions from PH-FRAT were included. The scoring of PH-FRAT questions was also modified, but with the similar indication to falls risk. This alteration in scoring did not affect the outcome, same answers lead to a conclusion of falls risk in both cases. The exclusion of BMI in the NRS-2002 and altered scoring and excluded sections of PH-FRAT did not cause any false positive results. Instead, it is possible that even more patients would have reached a positive result if all sections were included in the risk assessment. The ED falls risk assessment tool and 4AT are not designed for pre-hospital use. However, they are suitable for usage in the ED and contain general questions that can easily be asked already in pre-hospital setting. Performing the 4AT assessment as early as possible could reduce the risk of a false positive result as there has not been time for a patient to get delirium after arriving to a hospital.

It remained unclear why only 59% of the risk patients were reported to the ED as the reasons for the EMS not to report a patient could not be specified from the data.

It was not declared in this study what happened in the ED to the patients who the EMS reported as being at nutritional risk, falls risk or having cognitive impairment. Therefore, it is not known how well the information was received and whether it led to any actions. Finally, the results of the screening tools were not verified against diagnostic criteria, so the accuracy of the screening could not be determined.

14. Conclusion

This study demonstrated that the EMS can identify older patients in nutritional risk, risk of falls or having cognitive impairment. These health issues were common. Risk assessment should become a regular intervention in the EMS, and it might be beneficial to perform risk assessment on older non-transferred patients as well. Thereby, risk assessment performed by the EMS would have an even more significant role in health promotion of older people. Further research is needed on how the coverage of risk assessment and reporting the results at the ED could be improved and hence how information received from the risk assessment performed by the EMS could be utilized in the health care system to prevent future health problems and to provide the maximum benefit to the patient's overall health.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical statement

The study received an ethical approval from Helsinki University Hospital Ethics Committee. The research was carried out in accordance with good ethical practice. The work is authors' own and has not been published elsewhere.

Clinical trials number: NCT03759314

Appendix 1

Risk Screening Tools

The sections A-C are scored separately	
A. Risk of falls (6 items)	
Prediction of falls/self-reporting of falls over a 12-month period (6 items)	
A 1. Prediction of falls (2 items)	
Patient has fallen twice or more during last year	2 points
Patient takes six or more drugs	1 point
A 2. Self-reporting of falls over a 12-month period (4 items)	
No falls	0 points
One or more falls in past 12 months	1 point
One fall in past 3 months	2 points
Several falls in past 3 months	3 points
A. Total	
B. Malnutrition Risk (9 items)	
B 1. Nutritional status (4 items)	
No weight loss, or good appetite	0 points
Unintentional weight loss >5%/3 months or loss of appetite >25%	1 point
Unintentional weight loss >5%/2 months or loss of appetite >50 %	2 points
Unintentional weight loss >5%/1 months or loss of appetite >75 % or no appetite at all	3 points
B 2. Effect of diseases on food in-take (4 items)	
Normal nutritional requirements	0 points
Mild increase in nutritional need (Hip fracture, chronic illness, cirrhosis, COPD, DM, dialysis, cancer)	1 point
Moderate increase in nutritional need (Abdominal surgery, cerebral infarction, pneumonia, hematologic cancer)	2 points
Considerable increase in nutritional need (Head injuries, intensive care patient)	3 points
Age (1 item)	
Patient is aged 70 or older	1 point
B. Total	
C. Delirium and cognitive functioning	
Alertness/AMT4/Attention/Acute change or fluctuating course of symptoms (11 items).	
C 1. Alertness (3 items)	
Observe patient. If patient sleeps, try awakening by talking or touching shoulder gently	
Normal (alert, but not agitated during entire assessment)	0 points
Slightly sleepy <10 s after awakening, then normal	0 points
Considerably abnormal	4 points
C 2. AMT4 (3 items)	
Ask the patient: age, date of birth, place of study (name of the hospital or building), current year.	
No mistakes	0 points
1 mistake	1 point
2 or more mistakes/untestable	2 points
C 3. Attention (3 items)	
Ask the patient to list the months backwards by starting on December.	
Achieves 7 months or more correctly	0 points
Starts but scores <7 correctly/refuses to start	1 point
Untestable (too weak, sleepy, and unobtrusive)	3 points
C 4. Acute change or fluctuating course of symptoms (2 items)	
Evidence of significant change or fluctuation in alertness, cognition, other mental function (e.g. paranoia, hallucinations) arising over the last 2 weeks and still evident in the last 24 h	
No	0 points
Yes	4 points
C. Total	
Total score	
Section A1 Prediction of falls	points
Section A2 Fallings during previous 12 months	points
Section B Risk of malnutrition + Age >70	points
Section C Alertness/AMT4/Attention/Acute change or fluctuating course	points
Patient has at least one positive screen	Yes/No
Emergency department informed on a positive screen	Yes/No
There is food in the refrigerator	Yes/No
Patient has a meal service	Yes/No
Patient has other home care service	Yes/No

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